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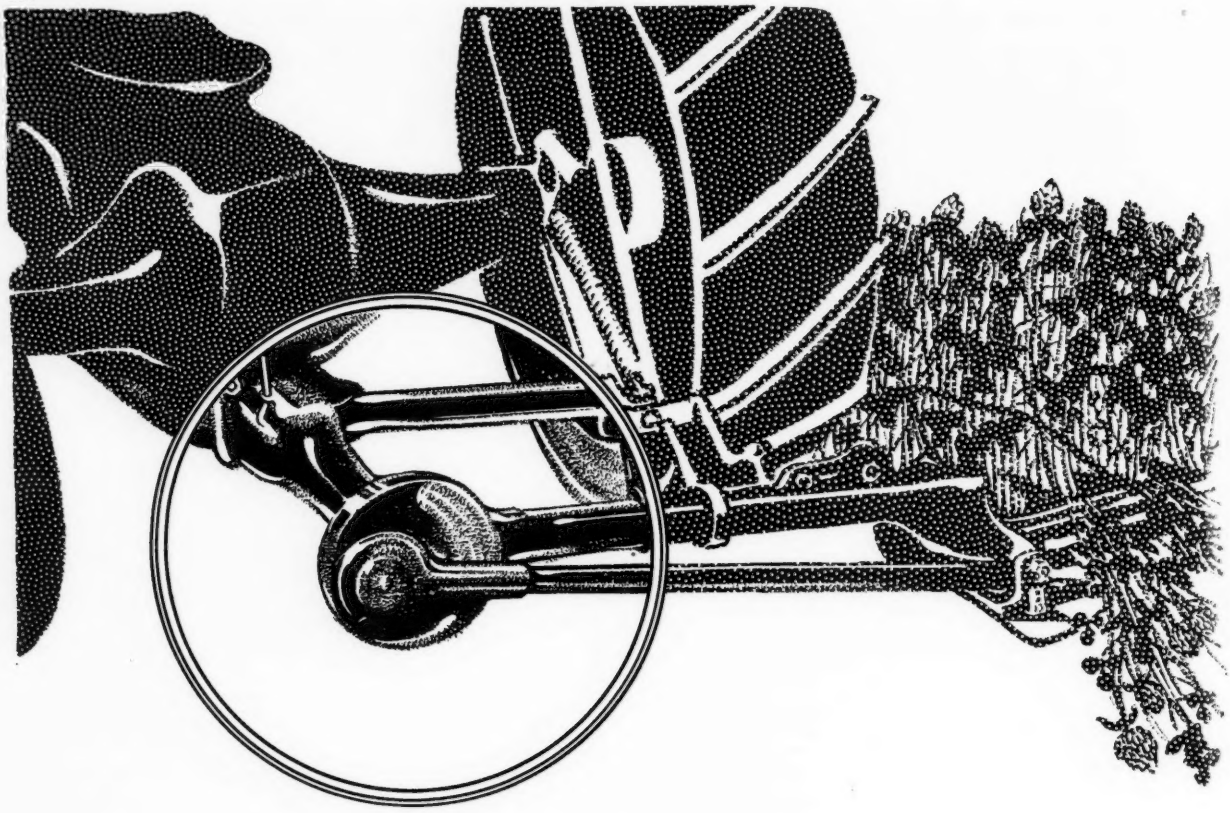

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Vol. 4 APRIL, 1923 No. 4

Development of Dusting Machinery For Boll Weevil Control*

By **Elmer Johnson**
Mem. A.S.A.E. Agricultural Engineer, U. S. Department of Agriculture

THE increasing world importance of the American cotton crop more and more brings into prominence the necessity for the development of some economic method for the control of the cotton boll weevil, which is the greatest enemy that the plant has at this time or has had for a great number of years. So fundamental is the cotton industry in its various ramification to the prosperity and progress of our whole country, constituting as it does our most important single agricultural crop and our largest single product of export, that it is no occasion for surprise that every class of our people are showing an interest in the crop and the reasons for the recent heavy loss in production.

The first appearance of the cotton boll weevil in the United States was in 1892 when it crossed the Rio Grande from Mexico at Brownsville, Texas. During the early years of infestation many studies for control was started at Victoria and later at Dallas, Texas. Little was known of the habits of the weevil in the inception of these studies and progress in control work was slow.

It was early discovered that improved methods of growing cotton, to include destruction of the stalks before frost to starve the weevil or increase their mortality during ensuing winters, together with better soil preparation, earlier planting of improved varieties of seed, better and faster cultivation to mature the crop early, would greatly reduce the numbers of weevils and lessen their damage. These practices recommended to the growers were not readily adopted.

In the meantime the weevil was spreading gradually from year to year, doing great damage as it went. No effective method of combatting it had been worked out and in many cases the loss was so great that many plantations were forced to abandon the growing of cotton.

In 1908 the government established the Delta experiment laboratory at Tallulah, Louisiana, for the purpose of continuing the study of methods for control of the weevil. This station, located in the Delta region where climatic conditions were favorable for the weevil, where the crop yields had been very heavy and where the weevil had caused heavy destruction, was well located for the work.

Not until 1916 was a successful method discovered. This was by the use of calcium arsenate, arsenical poison distributed on the plants in dry powder form and taken into the stomach of the weevil when drinking moisture from the plant foliage. The chemical composition of this poison to be most effective should be 40 per cent arsenic pentoxid, with not more than three-fourths or one-half water-soluble arsenic pentoxid, to insure its safe use on the cotton plant.

This poison applied in a finely pulverized dry powder form, preferably at night when the dew is on the plants to catch and hold the particles, spreads to and covers all parts of the plants, where it sticks and is available when the weevil takes his morning drink. It has been found that the poison is more effective when applied this way than when put on as a wet spray, for the reason that it can be more evenly distributed and does not form a crusty whitewash as in the case of the wet spray. In the regions where this treatment is used not only is wet spray machinery too complicated for the labor to use successfully, but when applied in the daytime each droplet of water sprayed on the plant acts as a tiny lens under the intense rays of the sun, and burning of the foliage is often the result.

The weevils live through the winter in rubbish piles, protected fence rows, about cabins, cotton gins and other buildings, or in the woods, from which they emerge in the spring at the first occurrence of warm days and the development of the cotton buds, on which it feeds until the squares or fruit of the cotton begins to form. It is in the cotton squares that the female weevil deposits eggs.

Both the male and female weevil drills into the square with its bill or snout. In the case of the male puncture the damage is not so serious, since the male weevil punctures the square solely to obtain food, but where eggs are deposited by the female and the larvae develops in the square, the square drops from the plant and the weevil continues to develop therein and to emerge therefrom as an adult. It

*Sixteenth annual meeting paper.

Hand gun dusters are only suitable on small acreages

takes an average of about 18 days from the time the egg is deposited until the adult weevil emerges. The average female will lay 140 eggs during a summer lifetime of 60 days. During the hibernation period the weevil lives for several months.

Various methods have been employed in trying to destroy or control the weevil. Hundreds of chemical mixtures have been tested, some as stomach poisons, others as contact poisons, and still others as poisons injected into the plant to be absorbed by the weevil when feeding, but the only economical method of control up to date is by the use of calcium arsenate as a stomach poison. In the early days the pickings of all damaged squares was tried, but was found to be ineffective and expensive to the degree of being unprofitable. Boll weevil catchers of various mechanical designs were tried but in most cases caught but few weevils and generally did more damage to the plants than the weevil itself.

In 1916 the entomologists in charge of the control work at Tallulah had satisfied themselves that arsenicals would if properly used give a certain degree of control. Up to that time lead arsenate had been used entirely in experimental work, but in 1916 experiments were begun with calcium arsenate, which was found to be satisfactory as a poison and much easier to handle in the then existing machinery than the lead arsenate. Manufacturers of insecticides were not equipped for making calcium arsenate in quantities at that time, and the supply required for this experimental work was furnished the laboratory only on special order. Lead arsenate having a density of about 60 cubic inches to the pound would pack easily and consequently was difficult to handle in the dusting machines. Calcium arsenate when correctly made has a density of from 80 to 100 cubic inches to the pound and is much easier to handle in dusting machinery, and being more fluffy does not pack so readily; consequently it is more easily broken up by the blast from the fans of the dusting machines and does not stick in the discharge piping as badly as lead arsenate.

Before 1916 hand guns only had been used in the experimental work. These were far from being satisfactory, either from the standpoint of operation or mechanical construction. They had been designed for small scale dusting operations such as in gardens and nurseries, where they would be operated by fairly intelligent labor. It soon became evident that a better class machine must be produced to stand the hard service given it by the labor available for cotton dusting, and as a result of the suggestions made by the Delta laboratory to manufacturers, several very satisfactory machines were later produced.

The use of hand guns in cotton dusting cannot be recommended except on small areas or in locations where other types of machines cannot be used for the reason that they are too laborious to operate, and require the operator to walk among wet plants. Being hand turned the poundage per acre of dust which they discharge varies with the energy of the operator, resulting generally in anything but a thorough job of dusting. As to the acreage capacity of hand guns a fresh man can cover only about one acre per hour for a period of two to three hours. After that time his speed will fall rapidly and for that reason not more than eight acres can be profitably assigned any hand gun for the season. Owing to labor difficulties weevil control should not be attempted with hand guns on more than 25 acres in one labor organization. If the acreage is greater than that it will pay to use a larger and more easily operated machine.

The acreage allotment to machines is governed by the area covered by each in one night and based upon the established schedule of poisoning at four-day intervals, which has been found to be the most effective. The most economical method of control so far developed is to start poisoning when 10 to 15 per cent of the cotton squares show weevil punctures, and continue to poison at four-day intervals, or as nearly as weather conditions permit, until three applications have been made. By this time the infestation is brought down to safe limits and poisoning discontinued until the infestation again reaches damaging proportion. Usually one or two later applications are all that are required, after a period of ten days or two weeks from the completion of the first series of dusting.

The orchard type of duster used for dusting cotton

In 1917 the interest shown by planters in this method of weevil control was so great that some attempts were made at commercial poisoning by using orchard dusters, which were originally constructed to handle insecticides having entirely different physical properties to those of lead arsenate, which was the only available arsenical then on the market in quantities. The experience gained from the use of these machines showed that considerable development would be necessary to adapt them to cotton dusting, so work was started on improving them to meet the new requirements. The most important changes were: First, improving the feeders to give a positive feed; second, the single swinging discharge tube for orchard work was replaced by a set of five smaller tubes so spaced to deliver the dust over the cotton rows, and each equipped with a nozzle to discharge the dust in a fan-shaped cloud to insure a thorough diffusing of the poison dust among the cotton plants.

The change in feeders consisted in introducing an auger to carry the dust from the hopper and deliver it into the discharge lines. This worked very satisfactorily and gave a much more uniform feed than that used in orchard dusting, which was simply a variable opening through which the material flowed by gravity.

The distributing system was constructed with the nozzles spaced 4 feet apart, giving a total spread of 16 feet from center to center of outside nozzles, the end sections being made either removable or to fold in against the sides of the machine for expeditions moving from field to field.

These machines, consisting as they did of a four-wheel truck with a 2 to 3 horsepower gas engine mounted thereon for driving the dusting machinery, weighed when loaded and equipped for the field about a ton, and were therefore rather cumbersome to handle, particularly when turning at the ends of rows and in avoiding obstructions in the fields, such as stumps and logs. In making such turns a great amount of damage was done the cotton plants by the team and four wheels of the vehicle. Two men were required to operate this type of duster, one to drive the team and one to operate the machinery, and with the class of labor available on the average cotton plantation the gas engine alone proved

too complicated for them to keep in operation, and as a consequence, with the numerous other parts of the truck and dusting machinery to keep in repair the machines stood idle in the field, a large part of the time waiting for intelligent supervision of repairs.

The experience with these machines in 1917 and 1918 convinced those concerned that a cotton duster of more simple construction and requiring less care in operation must be developed, so work was started on a duster of smaller capacity more simple in construction and operation. This consisted of a two-horse three-row duster getting its power through chains from the traction wheels, thus eliminating the engine and requiring only the services of the driver to operate. A machine of this type was tried out for one season in 1919 and proved satisfactory, so that early in 1920 tentative designs were sent to manufacturers building this class of machinery. Several models of this type were soon under construction and on the market for the dusting season of 1920. The drawings were sent merely to give the manufacturers overall dimensions and a general idea of the requirement of this duster, the details of construction being left to their designers to work out to meet their factory conditions and equipment. Some models presented were useless in spite of the detailed description of conditions to be met as presented by the Delta laboratory, while others met these conditions and have established a trade for their machines in all cotton states. This type of machine is adapted for use on fairly level land and will handle under average conditions 35 acres of cotton in a night of operation or 100 acres in a season.

As the dusting operations became more popular with farmers it was evident that a machine of a size to meet the needs of the farmer growing less than 100 acres of cotton was going to be greatly in demand, so in 1920 a one-horse two-row duster was built at the Delta laboratory and proving satisfactory under tests, drawings were sent to interested manufacturers, with the result that two different makes of this type were on the market for the 1920 dusting season. Since then several other firms have been turning out this style duster, some of which are radically different in design from the original but work very well under certain conditions of cultivation and land contour. The single-wheel type with shafts, as designed by the laboratory, if properly proportioned with center of gravity low, will work under almost any condition, while the two-wheel type is better suited for level lands and flat cultivation.

In fields inaccessible for horse-drawn dusters it has been a common sight to see a negro operating a hand gun from mule back. This method had the advantage of saving the operator from walking, kept him above the wet plants and with the gun in a convenient position for directing the dust cloud down into the foliage. This obvious advantage led to the development of the saddle or mule back duster, the distinction between the two being that one is rigidly attached to a saddle, while the other is strapped to the operator and has a flexible support on the bottom for resting on the animal's wethers, the operator riding bareback.

A saddle gun cotton duster shown in actual operation

Of the two the saddle gun is to be preferred, as it leaves the rider free to protect himself in case anything goes wrong with the mount. The early models of these guns were merely two hand guns built in a single unit back to back with a single hopper serving both and requiring continuous cranking with both hands. All adjustments for changes in height of nozzles were made by substituting tubes of different lengths. Later models of saddle guns designed for that purpose have the advantage of being better balanced, can be cranked by one or both hands at the convenience of the operator, and the nozzle height can be controlled by swinging the tubes from the perpendicular to horizontal or other positions. This is accomplished by having the fan housing constructed to move and be locked in any position around the fan. This is not only an advantage for adjusting the nozzles, but permits the rider to swing the tubes out of the way when mounting and dismounting. These dusters have the same acreage capacity as the one-horse machine and can be used at any time and place that an animal can walk in the field. However, they have the disadvantage of being hand operated, and having a comparatively small hopper capacity of from 15 to 20 pounds of dust, which in ordinary dusting would last about 1¾ hours, or requiring refilling five or six times a night.

Since most of the dusting is done at night some sort of illumination must be provided, particularly on any two-horse machine, for the reason that with two animals to handle and a somewhat top heavy vehicle the driver must be able to distinguish objects clearly a reasonable distance ahead to avoid collisions with obstructions and to find the right rows when turning at the ends. Also some light is necessary to make the machinery and nozzles visible to the driver.

Practically every kind of light on the market that could be considered for such a purpose has been given a trial on this work, and up to this time there has been but one that would meet the requirements of being reasonably simple, furnishing sufficient light and standing the extreme rough usage to which they are subjected both on the moving machine and in general handling.

In the process of elimination oil lights did not furnish enough illumination, gasoline lights were dangerous and the mantles would not stand the vibration and were discarded. Compressed gas and storage battery systems proved unsuitable, for the reason that when the charges ran low the service would be poor and replacements not made usually until they failed entirely.

The carbide flare light in use at the present time is automatic in operation requiring no attention after starting. It uses a specially prepared carbide cake and with a full charge will burn 12 hours, giving sufficient illumination to clearly distinguish objects 200 feet in front of the team with plenty of light on the duster and nozzles. The bottom of the 12-inch reflector is cut away to allow the shedding of lights to the back. On the one-horse machine where the implement follows close to the animal and the hazard of upsetting is not so serious, an ordinary dash-board lantern gives sufficient light and while the average trouble of an oil light is experienced it has proven very satisfactory for this machine. No really satisfactory light has been found for use with hand and saddle guns, in fact with these machines, where the operator is so close to them, it is only occasionally that

light is really needed, and then only for recharges or making adjustments. Any kind of a continuous light carried so close to the operator introduced the very objectionable feature of attracting hoards of flying insects. So far the ordinary pocket flash light has given very good service with these machines.

Most prospective dusting machinery manufacturers obtain such data as is available on the machines they contemplate building and construct models, which they submit to the Delta laboratory for testing and suggestions, for further improving their machines to meet the various conditions that have been brought to the attention of the men in charge of this work there, and who have a good idea of the difficulties to be overcome, outside of those pertaining to the details of designs of the dusting machinery proper.

While such tests as can be made at any season of the year will not bring out all of the weaknesses of a machine, they will show up the performance of parts that must be right to begin with.

A horse-drawn duster is given a field test of several hours duration, in which the discharge in pounds per acre is determined for different settings of the feed lever, thus giving an idea of the performance of the feeder through its full range of adjustments. Draft readings are taken under the different conditions in the field, and a short draft test is made on a surfaced road with the machine both in and out of gear. This data gives us an idea of the total load on the team as well as the power required to operate the machinery.

During the dusting season these machines are put in the field and a careful study made of their performance.

Tests on hand and saddle guns are made in the field under as nearly practical conditions as possible, to determine their ease of operation and general performance. Discharge and endurance tests are made on a test block where all conditions except humidity are uniform and where the test can continue through any period of time. This test block is also used to drive the machinery on such experimental work as determining the effect of humidity on the handling of calcium arsenate and other problems that are to be worked out.

During the summer of 1922 arrangements were made between the Department of Agriculture and the U. S. Government Air Service for a series of experiments to be made in dusting cotton with airplanes.

Some work had previously been done along this line in dusting fruit and shade trees, and the results appeared promising; however, the extent of these operations had been very limited and definite conclusions could not be drawn from them as to the practicability of this method as applied to cotton dusting work where the conditions are vastly different.

Two Curtis type airplanes sent from the Montgomery (Alabama) Field were used during the entire month of August testing dusters and as far as possible the utility of this method of dusting for boll weevil control. Owing to the lateness of the season, little could be accomplished towards the control of boll weevil, since at that time the cotton crop in the vicinity of Tallulah is practically made. However, at that time the cotton leaf worm had invaded the fields where experiments were being conducted and the effectiveness of this method of dusting was found to be highly satisfactory for the control of this insect.

Before starting the airplane work some doubt was entertained as to the ability of the planes to fly low enough over the cotton to prevent the dust cloud being carried away by stray breezes. These fears were soon dispelled when the ships were equipped with dusters and the work begun, for it was found that the planes could be made to simply skim over the

An airplane in flight leaving cloud of "dust" behind

tops of the cotton and in many cases picking the tassels from stray stalks of corn. As to the action of the dust cloud delivered from the planes this way was very satisfactory even in a light breeze. The propeller wash of the plane while in flight being downward and to the left and rear creates in the air a sort of tunnel of eddying currents which thoroughly mixed the dust with air and carries it down among the plants.

The first duster constructed for airplane work built by the War Department consisted of a dust hopper with a hand-operated, paddle-wheel feeder, located to the right and on the outside of the observers cockpit. On the arrival of the planes at Tallulah this hopper had not arrived so another was constructed with the same type of feeder, but to be located in the front half of the observers cockpit where it would offer less air resistance, be more convenient to crank, keep the ship in better balance and discharge the dust through the bottom of the fuselage. This duster while crudely constructed worked fairly satisfactorily for the time being. It was soon evident, however, that some type of feeder which would vary the discharge of dust with the speed of the plane was necessary, if the poundage of dust per acre was to be kept uniform, therefore, work was started on an automatic air-feed hopper which has no moving parts except a sleeve valve for regulating the size of the dust outlet opening. The theory in this type of feed is that the air collected in a funnel located above the wings of the plane rushes down through a comparatively small connecting pipe which extends to within a few inches of the bottom of the hopper where the sleeve valve is so constructed as to increase the cross sectional area of the air outlet several times. When the valve is raised, sliding up the air line as a guide, dust is free to flow out under it, and the high velocity air current through the small air pipe carries it out through the discharge pipe extending through the bottom of the plane.

The passage of the air current passed the enlarged section where the valve seats tend to create a vacuum at this point which accelerates the flow of dust proportional to the velocity of the air current and since the speed of the plane varies the velocity of the current, the discharge will vary accordingly. Small auxiliary air lines leading from funnels on the side of the hopper keep the dust cut loose from sloping parts and flowing towards the feeder.

It is the intention of the Department of Agriculture in cooperation with the Air Service of the War Department to begin further experimental work on airplane dusting immediately after January first (1923), with the idea in view of developing cotton dusting on a commercial scale for the coming summer using different types of planes equipped with the most efficient dusting machinery that can be worked out in that time.

Agriculture and the Agricultural Engineer

By Samuel Fortier
Associate Chief, Division of Agricultural Engineering, U. S. Department of Agriculture

THE enormous losses suffered by the farmers of this country during the past two years and the difficulties to be overcome before the basic industry of farming can again function normally reminds one of another crisis that threatened the very existence of this republic. I refer to a time more than three score years ago when the political platform of the ablest leader of that time was summed up in the phrases so full of meaning: "This Nation cannot long endure half slave and half free—a house divided against itself cannot stand." This great issue was decided by the arbitrament of war, but the mental wounds then inflicted are not yet all healed nor are the debts all paid.

While the issue today differs from that of 1858 to 1861, there are points of resemblance which command our attention and deserve our earnest consideration. The dread that this Nation may not long endure has not been wholly removed from our minds. It has seemed of late that after liberating the black race at so great a sacrifice, we were bent on enslaving a white race—that we were endeavoring to make serfs of the millions who toil in fields or perform the drudgery of rural homes in order to provide pleasures and luxuries for the dwellers in cities. I have no desire to stir up strife between classes or to array rural communities against their friends and relatives in cities, yet I feel that it is as true today as it was sixty odd years ago, that a house divided against itself cannot stand. Interpreting this war-worn saying in the language of the present, it means that the artisan, the merchant, the builder and that ever increasing class of "middlemen" cannot prosper if agriculture languishes and continues to yield mortgages instead of profits to its followers.

This morning over a hundred million people in the United States got out of bed hungry and demanded breakfast. The fruit, cereals, bacon and eggs and coffee which they consumed in the morning were robbed of their nutrients by noon and they again wanted something to eat. When evening came, they were again hungry and demanded something even more appetizing and varied than they had got at either of the previous meals. So this gigantic task of feeding the people of this nation goes on from day to day and from year to year, and it is gratifying to be in a position to state that thus far in our history, relatively few have not been regularly fed. Ample foodstuffs and clothing have been provided by the men, women and children who work on farms. Each little group of workers, as they cluster around the common living room when the day's work is done, may well feel content at having contributed their share towards keeping the body and soul of this nation together. However, contentment does not reign in these humble abodes. The large majority are dissatisfied with their lot. They feel that they have been discriminated against and have not had a square deal. As someone has recently said, "The losses of maladjustment and readjustment have fallen on the farmers." Millions of good farmers on good land and with good crops are going behind financially and are having their physical and moral well-being impaired.

No one will ever know the direct loss sustained by the agricultural classes during recent times. In so far as I have been able to estimate the loss, it will amount to eight billion dollars, apart from the shrinkage in value of improved land and other farm property. If such a calamity had befallen the industrial classes, there is reason to believe that it would have brought on a revolution. It would therefore appear that once more agriculture has proved to be the safe anchor of the republic.

In 1920 the prices of ten leading farm crops was more than double that of 1921 and 1922, yet the cost of production had not been materially reduced. When one recalls that the farm value of only one of these crops, that of corn, was over 3½ billion dollars annually from 1917 to 1919, and that it was less than 1½ billion dollars in 1921, he gains some idea of the enormous loss inflicted on the growers when all crops are considered. By producing bumper crops below cost, nearly every man, woman and child have had three meals a day, but the urban population do not realize how much farm workers have suffered in meeting this obligation. For two years, nearly everything the farmer has had to sell has been low and everything he has had to buy has been high. He has worked harder and longer hours each day, his living expenses have been reduced, pleasures and luxuries have been denied and the borrowing of money to pay the interest on the mortgage has only given temporary relief. He also finds himself handicapped in getting returns for the future. His stock has been reduced, his equipment needs repairs and renewals, the price of wearing apparel is still high, and he cannot afford to hire help. As a further cause of discouragement, his farm with its improvements has shrunk in value so that the capital which he hoped might one day care for him in his old age has been in many cases reduced to one-half the former value.

It is fortunate for California that she has not suffered to the same extent as her sister states. There has been little slump in the prices of fruit and other kindred products in this state, and as a result the orchardists in particular have little cause for complaint. On the other hand, conditions are bad in most of the Rocky Mountain states. Some idea of the setback which has occurred in other parts of the West may be learned from one of the federal irrigation projects in Idaho. From 1917 to 1919 inclusive, the settlers on this project paid the government in full with a few minor exceptions for all construction, operation and drainage charges, but on November 1, 1922, the charges for 1920 and 1921 were delinquent to an amount equal to $539,000 and the charges for 1922 due this month will soon increase the indebtedness to nearly $750,000.

There was a time in the history of this nation when farming was the chief occupation of its inhabitants. As the years have been unfolded, and the census data for each ten-year period revealed, the percentage of the total population engaged in agricultural pursuits has grown less and less. The chief reason for this falling off is that farming does not pay as well as other occupations and there are more hardships and privations to be endured. The last census showed that when the income received by workers in various callings was compared, for every $10 which the farmer received, the railroad and other transportation worker received $22, the merchant and clerk $21, and the manufacturer and artisan $17. If there be this disparity in normal times, how much greater must it have been in a year like 1921.

*An address before a meeting of the A.S.A.E. members on the Pacific Coast held in San Francisco, December 15, 1922.

Then too, the good times for the farmer which prevailed after the close of the war were of short duration, but while it lasted the trend of the population was toward the farm and away from the cities. The misfortunes which have of late befallen the agricultural classes have caused the tide to set strongly in an opposite direction and cities are being over-crowded with recruits from the country. A nation-wide effort is needed to stem this tide, restore agriculture to a position commensurate with its importance and thereby stabilize all other industries.

One does not like to think of what would happen if the farmers of this country were to strike or to confine production to what was needed to supply the 6½ million farm homes. With the experience of Russia since the revolution so fresh in our minds, we dare not hazard an answer. A few years ago we thought of Russia as a great nation and seemingly well-balanced. It had its commerce and railways, its towns and cities, its mines and manufacturies, and its surplus foodstuffs were transported in large quantities to foreign countries. Of all its former greatness, little remains save agriculture and on this solitary cornerstone a new nation is being built. With so frightful an example of misconduct and misrule before our eyes, we should be the more ready to strengthen the weak features of our own nation, and to my mind the weakest feature at present is agriculture. Strengthen this one basic industry and you add immeasurably to the strength of all. On the other hand, we have merely to make farm work unprofitable and deprive the occupants of rural homes of much needed profits and comforts to destroy not only this industry and all others, but the republic itself.

I have chosen this subject for this occasion not on account of my ability to present it, but rather on account of its importance. I feel assured also of your sympathy and support. Your work as agricultural engineers and members of state agricultural colleges and experiment stations tends to make you familiar with farm conditions and farm problems and frequently brings you in close touch with farm life. I know of no class that can help the farmer more. The question which now confronts us is, How can we help? What can we do to put agriculture on its feet? Even to outline such a task is much beyond my capabilities but in the short time remaining I shall attempt to call your attention in a very general way to a few phases of this problem.

I would first direct your attention to the soil. In 1920 crops of one kind or another were grown on 365,000,000 acres and there were in addition 138,000,000 acres of improved land uncropped or in pasture. The forest, grazing and desert lands contribute over 57 per cent of the total land area but in addition to the half billion acres of improved land, there are about 170,000,000 acres of swampy, arid or cutover lands which might be drained, irrigated and freed from stumps if funds were available. This you will observe is a task which properly belongs to the agricultural engineer, but he is powerless to accomplish anything without money, and it is not clear where the money for reclamation work of this character is to come from. Judging from the past, I do not believe that farmers of limited means can pay for reclamation and at the same time put their farms on a paying basis without substantial assistance from either the nation or the state or from both. In the days when the building of irrigation systems by corporations was popular in the West, very large losses in the aggregate were sustained by capitalists. Out of over one hundred Carey Act projects, only four have been profitable investments to the men who financed them. Were it not for the fact that no interest is charged on construction costs, the majority of Reclamation Service projects might be in the hands of receivers. In view of this showing, the prospects are not bright to irrigate much more arid land or to drain swamps at the sole expense of the settler. In casting about for ways and means of aiding farmers to accomplish this task, one realizes at the outset that farmers acting independently can do little either in the way of draining land or providing a water supply for arid land. They must organize, and one of the best forms of organization is the irrigation and the drainage district. Up to July 1, 1921, 598 irrigation districts had been formed in the 17 western states, including an area of nearly 16,000,000 acres and voting long term bonds to the extent of $281,000,000, of which over $118,000,000 have been sold. What the individual is powerless to do may be brought about by well-directed cooperation. This is strikingly shown by the building program of the Turlock Irrigation District about to be completed at a cost of over $4,000,000. With proper organization and management, long-term bonds and a rate of interest thereon reduced through state and federal legislation to a minimum, much might be accomplished.

To provide for normal expansion, it is necessary to reclaim by irrigation at least half a million acres a year, and to drain more than double this area. Owing to adverse conditions, this yearly expansion is likely to fall short of the average for some time to come, and if so, the improved land in crops will have to produce more. The task ahead is to increase production and lessen the cost. Even in this the engineer can help because for the irrigated lands it means a better use of water and a more thorough preparation of land to receive water and for the whole country it means better farm structures, better equipment and better transportation facilities.

It would be unwise, however, to emphasize too strongly the mere production of foodstuffs and materials for wearing apparel. Nothing is more discouraging to the farmer than to labor four months to grow a crop and have it rot on the ground for lack of markets or transportation facilities. While it is difficult to predict what will happen between seedtime and harvest, much more might be done to keep the farmer posted, to advise him what to produce and how to produce it. Above all, when the crop is harvested, he should not be compelled to sell at a sacrifice in order to get money to carry on. A harvested crop or even a prospective crop like young stock should afford security for temporary loans. With the establishment of a more favorable and more general system of farm credits, with better facilities for storing soil products on the farm and in community warehouses, with ample facilities for transporting products at reasonable rates and a cooperative system of marketing to lessen the difference between the growers' and consumers' prices, many of the handicaps which at present distress and cripple the farmer, would be removed.

In treating a patient so shot to pieces as the American farmer is at present, many remedies are needed. I have tried to point out a few but there are others. Consider, by way of example, the subject of roads. I used to think good roads would be a fine thing for the farm folks. I am not so sure of it now. I can remember the time when the peddler with a heavy pack on his back was very grateful for a ride in a farmer's wagon. Now this ex-peddler with his limousine is crowding the farmer's bay mares completely off the highway. The farmers should not be called upon to pay more than their proper share for good roads. It should be somebody's business to find out who uses the highways, and better still who wears out the highway, and tax them accordingly. In other words, there should be an equitable adjustment of first cost and upkeep in proportion to benefits received.

There is, however, another phase of American agriculture far more in need of a remedy than the equitable adjustment of road taxes. I refer to the housing and sanitary conditions of farm homes. I have never been able to understand why this particular feature of a basic industry should

be so long neglected. The federal government in conjunction with the state experiment stations has expended millions of dollars for the health and betterment of livestock. Other millions have been expended by the same agencies in the development, improvement and protection of useful plants, but no one seems willing to contribute a dollar in making the majority of farm homes comfortable or healthy.

There is no good reason for this discrimination. According to the last census, the amount of money invested in farm buildings amounted to 11½ billion dollars in round numbers, while that invested in livestock was only a trifle over 8 billion dollars. Now just why we should spend so much money every year on the investigation of livestock and practically none on the investigation of farm dwellings and other buildings, I am wholly at a loss to state. Those who travel through the rural communities of this country know that there are millions of farm homes in which the only domestic water supply obtainable is hoisted out of a well by a greasy rope attached to a dirty bucket and carried by overworked women and children into the kitchen. Even this might be endured but the invariable counterpart is to carry out the slops and all the household waste and deposit this filth within a few yards of a dwelling. If Congress and the various states acting through the agricultural engineering departments of their land grant colleges could see their way clear to set aside each year even a relatively small fund to be used in improving the domestic water supply and sanitation of farm dwellings and in the better design and construction of rural buildings in general, it would go far to make agricultural workers more contented with their lot. It would tend to keep boys and girls on the farm and it would raise the efficiency and increase the output of each farm unit. The opportunities along this line are very great. For centuries good materials have been improperly used for the reason that the owner did not know how to build. Proper design, the introduction of labor-saving devices, such as piped water to the kitchen sink and the removal of the waste to a safe receptacle, these and many other betterments might be made at small cost providing the one who did the planning understood his business. Then when the new dwelling is built, it is so easy to grow grass, and plant vines, shrubs and shade trees for its adornment.

While we are on the subject of farm dwellings, I wish to mention one more thing and then I am through. Every rural settlement in the land should have a community house. There is no lack of churches for the tendency of Protestants is to split along doctrinal lines and for each denomination to erect its own village church. Now in addition to churches and their good influence, community houses are needed not to keep people apart but to bring them together. As someone has said, such meeting places should be as democratic as a street car. It is a place where people of all religious beliefs and all classes should come together for amusement, social duties and enlightenment. The recent tendency is for the city to annex the country, to induce rural folks to come to the city for all of their amusement and with all their spare cash. This trend is adding to the discontent so prevalent in country homes and abetting the movement of people from the country to the city. A community house in each village would tend to provide much needed diversion and recreation, raise the standard of living, improve dwellings, introduce labor-saving devices, and in short constitute the forum for all farm activities, whether pertaining to the home or to the field.

I may be mistaken, but in watching the course of events within this nation during the past two years, I have felt that we were rapidly approaching the parting of the ways. On the horizon of one way I fancy I can see Poverty and Misery, like birds of evil omen, perched on the gate posts of the farmsteads of this land, while Hunger in her ragged mantle walks the streets of cities. I see strikes, labor arrayed against capital, the destruction of property, the breaking down of transportation, commerce and industries, the debasement of the currency, the red flag of revolution and the overthrow of much that we prize more than life itself.

On the other horizon I fancy I can see a prosperous rural population with agriculture exalted to its rightful place among its sister industries. The mechanic has a full dinner pail and more than a living wage, the merchant is prosperous, the dwellers in towns and cities have their pleasures and comforts and the whole nation is so coordinated in all its working parts that worthy achievement along all lines of endeavor is assured.

Which road shall we take? Which goal shall we reach?

Tractive Resistance of Roads

INITIAL results secured from an investigation of the tractive resistance of roads indicate that information of great value to the highway engineer and the user of motor transport will be secured. The investigations are being carried on under the auspices of the Advisory Board on Highway Research of the National Research Council with which the Bureau of Public Roads of the United States Department of Agriculture and the Quartermaster Corps of the United States Army are cooperating.

One phase of the investigation shows that there is a great difference in the power required of the engine when a truck is traveling over different types of surfacing, the amount being more than twice as great on some of the lower types when compared with that on higher types. It is also shown that the power required to overcome the road resistance is not proportional to the speed of the vehicle, and after a certain speed is reached increases very rapidly.

The investigation when complete will cover tests with various types of motor vehicles with the load, tire, and spring equipment varied on different types of surfacing and at varying speeds. The data will include gasoline consumption, internal engine resistance, wind resistance, and road-surface resistance.

When carefully analyzed it will aid the highway engineer in determining under a given set of conditions what type of surface should be built for a given volume of traffic to result in the least total cost for road and vehicle operation. The same sort of study will be made as to expenditures for grade reduction to reduce operating costs.

The truck operator will be given valuable information on the effect of tire and spring equipment, lubrication, size of load and speed of vehicle on fuel consumption which should aid him in producing cheaper transportation.

Raising Standard of Engineer

HERBERT Hoover, Secretary of Commerce, recently made this statement: "I am convinced that the Federated American Engineering Societies is contributing more to raising the standard of American engineers in the general estimation of a community than any other agency that has yet been in existence. They have certainly done fine service at Washington for the government and the various departments, but far and beyond this the Federated American Engineering Societies has awakened the American public to the great civic potentialities of the engineering profession. The reports on the twelve-hour day and waste in industry have been worth several times every penny expended in this effort. I have the feeling that many engineers believe that the status of the profession is to be advanced solely through our (the engineer's) handiwork. They do not recognize that it is one thing to do a job but quite another thing to educate the public to understand who has to do it and who is the man to be called upon."

Agricultural Engineering Development in Virginia

By **Chas. E. Seitz**
Mem. A.S.A.E. Professor, head of the department of agricultural engineering, Virginia Polytechnic Institute

AGRICULTURAL engineering has been "sold" in Virginia as is evidenced by the progressive development of this work at the state agricultural college. Back in 1913 a curriculum in agricultural engineering was adopted at the Virginia Polytechnic Institute, leading to the degree of Bachelor of Science in Agricultural Engineering. This curriculum was offered under the agricultural school, and the subjects were divided between this and the engineering school. But, there being no department or individual directly responsible, this course proved a failure and was dropped from the catalog upon the advent of the new president in 1919.

However, in 1914 the extension division employed a specialist in agricultural engineering to give the farmers of the state demonstrations in the proper methods of draining their wet lands. This extension work proved very effective and the demand for information on all phases of agricultural engineering grew so rapidly that by 1917 demonstrations in other agricultural engineering problems were begun. This extension work was handicapped, however, by lack of a regular college department of instruction and research in agricultural engineering. The effective extension work in progress treated a demand for resident instruction in real agricultural engineering subjects, and in 1920 a department of agricultural engineering was established at the college with the extension specialist as its head. Two men were added to the department staff, J. S. Glenn and H. B. Boynton, both graduates in agricultural engineering at V.P.I. Each was employed for six months extension work and six months resident instruction.

In 1922 the department again enlarged its activities. Research in agricultural engineering was started and a four-year course in agricultural engineering was adopted in which agricultural students could major in this work. Two additional men were added to the instruction staff, J. A. Waller, and R. C. Hubbard. Mr. Waller is a graduate of the Virginia Polytechnic Institute and the University of Nebraska. He has charge of the instruction work in farm power. Mr. Hubbard is a graduate in agricultural engineering at the Mississippi Agricultural and Mechanical College and is employed as fellow instructor in agricultural engineering. Two student assistants are also used at various times throughout the year. Miss Helen Hughes is secretary for the department and has charge of all drafting, tracing, blue printing, and chart work.

This year the major course in agricultural engineering has been changed to the professional course, leading to the degree of Bachelor of Science in Agricultural Engineering. This step places the Virginia Polytechnic Institute in a class with the Iowa, Nebraska, Kansas, Missouri, and Texas state colleges which are giving professional courses in agricultural engineering.

The department gives instruction to agricultural students in the following subjects: farm structures, farm implements, agricultural drawing, graphic methods, farm power and machinery, and farm surveying and drainage. In addition to the above, the department gives instruction to the men enrolled in the agricultural engineering curriculum in the following subjects: farm motors, motor vehicles, water power and electricity, advanced farm power and machinery, rural sanitary equipment, farm concrete, agricultural engineering problems, land reclamation, rural architecture, and advanced farm surveying.

Besides the instruction work for regular students, the department conducts a number of farmers' short courses each year. In 1922 six farm power short courses were given with a total attendance of two hundred and sixty-two. The average length of these short courses was eight days. A six-day course was given to the agricultural high school teachers of the state with fifty in attendance.

While the housing facilities and equipment are by no means what they should be, the department is about as well off in this respect as the majority of the younger agricultural engineering departments in the colleges of the country. The department has 2500 feet of floor space in Agricultural Hall, which it uses for offices and rural architecture and surveying laboratories. Three large lecture rooms are available for department use. About two hundred feet to the rear of Agricultural Hall the department has its farm machinery laboratory. This is a frame structure, fifty by one hundred and sixty feet and houses practically all of the farm power equipment. About eighty farm equipment companies are

Office of the V.P.I. agricultural engineering department

Agricultural hall at Virginia Polytechnic Institute

cooperating with the department by furnishing, on a loan basis, farm power equipment valued at about $15,000. Thirty men are at present enrolled in the four-year course in agricultural engineering and these men have recently organized a live student branch of the American Society of Agricultural Engineers.

As provision for research work was not made until July, 1922, with only part time of one of the engineers available, not much investigation work has been done as yet. However, some work has been started. Drainage studies are being conducted along two lines, namely: the economics of tile drainage, and factors influencing the success or failure of tile drainage systems. Investigations have also been started in farm water supply and the power development of small streams for farm hydroelectric plants. Considerable progress has already been made in the hydroelectric studies. This work is being undertaken in cooperation with the division of agricultural engineering of the U. S. Department of Agriculture.

Investigations were made on several farm streams in certain counties of the state in order to determine the approximate amount of water power that is going to waste, which could be utilized for the generation of electricity for the farm homes near the sites. Preliminary surveys were made on these selected streams, and for selected distances along each stream in order to determine the number of plants which might be developed on the portion of the streams surveyed. An economic study was made of each site in order to compare the advantages of developing the site as a water power plant with the installation of a gasoline-driven plant of equal capacity. In each case, wherever the development of the site was found feasible and economical, an endeavor was made to interest the owner to proceed with the installation of a plant.

The data in regard to farm stream development is now being prepared and will be published in bulletin form. This bulletin is to be a practical treatise on developing farm water power; so that farmers having streams capable of advantageous development may not only be brought to realize the dormant possibilities of such streams but shown how to proceed with the preliminary steps to determine the approximate capacity of the stream and to make a rough estimate of the cost of installation.

The extension work of the department is carried on by correspondence, newspapers, farm journals, meetings, short courses, and actual field demonstrations. The principal extension projects in agricultural engineering in which demonstrations are given are: land drainage, terracing, farm power and machinery, boys' club short courses, farm hydroelectric development, water supply and sanitation, farm buildings and farmstead planning, and miscellaneous farm engineering problems. The past year was the most successful since the organization of extension work in agricultural engineering in Virginia. The engineering specialists conducted demonstrations in seventy-four of the one hundred counties of the state and actually met or visited 3,497 people and addressed 4,839. From the office 2500 bulletins on agricultural engineering subjects were mailed out to farmers requesting them, and 4,000 letters were written to individuals.

Drainage is one of the most important extension projects of the department and during the past year 114 tile drainage demonstrations were conducted on 4,640 acres of land. On seventy-four of these farms only preliminary surveys were made but on the other forty farms complete surveys were made and maps prepared for comprehensive drainage systems. A number of these systems have been completed. In addition to the tile drainage projects, one large drainage project has been started by the organization of Norfolk County Drainage District No. 2, comprising 15,000 acres of farm lands.

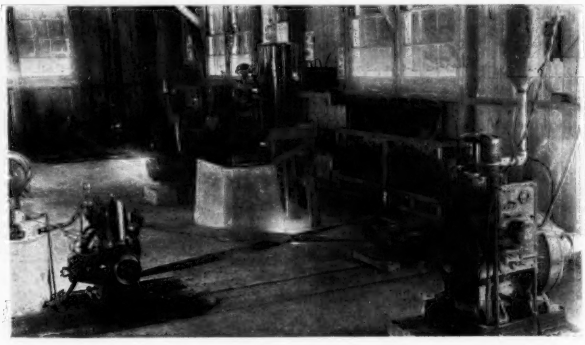
Terracing is another of the important extension projects of the department, as soil erosion is a very serious problem in ten or twelve of the southern Piedmont counties of the state. Thousands of acres have been abandoned because of excessive soil washing. This represents a big economic loss to the state as well as to the individual farmers. The department is devoting much time to this problem and during the past year seventy-five terracing demonstrations were conducted in ten counties in cooperation with the county agents in these counties. The county agent selects the demonstrator, handles the publicity and has all the preliminary arrangements made for the engineer when he gets to the county. Terraces are laid out on the fields selected and at least one model terrace constructed by the use of the home-made terrace drag. At some of the larger demonstrations, the local implement dealers cooperate by furnishing tractors and terracing ditchers. Last year sixty-three miles of terraces were laid out on 1,230 acres of land and 550 farmers attended the demonstrations. The demand for assistance in terracing has grown to such an extent that the department cannot meet all these requests.

The extension projects in farm power and machinery are handled almost entirely through field demonstrations, and short courses. Six farm power demonstrations were held last year. At these demonstrations, tractors and modern power implements were shown in operation doing various kinds of work. Great interest was shown by the 2,190 farmers attending. Tractor plowing demonstrations have not been handled by the department in the last few years, as it is felt this type of demonstration has served its purpose in the state. Previous to 1920, however, such demonstrations were very popular and many were held each year. In 1919 seven tractor plowing demonstrations were conducted with a total attendance of over 30,000 farmers. At one demonstration alone there were over 10,000 farmers in attendance. In addition to the farm power demonstrations last year, six extension short courses were conducted. The department also has charge of the farm machinery exhibits at the state fair each year, which has enabled the members of the department to become acquainted with a large number of farm equipment men. This acquaintance has proved very valuable in securing equipment for the farm power laboratory.

The department is cooperating very closely with the Boys' Club Department in handling the club short course project. Six extension short courses were held last summer in different sections of the state with an attendance of 424 boys. The average length of these courses was five days. The department gave instruction at these courses in farm machinery, gas engines, tractors, lighting plants, water systems, concrete construction, rope tieing and splicing, and radio. This club work is one of the most important of the department's projects as it gives an opportunity of selling agricultural engineering to the boys. A certain number of these boys, upon entering college, will in all probability enroll in agricultural engineering. All of the boys take an intense interest in the work. At the state club encampment held at the college last year, 140 out of the 222 boys in attendance enrolled in the farm mechanics course given by this department.

Hydroelectric development is fast becoming one of the important extension projects of the department. The object of this project is to demonstrate to the farmer the dormant possibilities of the average small stream, and to show him how to harness this wasted power for his profit and for the increased convenience and comfort of his family. Virginia is blest with thousands of small streams, some located in each county, and flowing through innumerable farms. In many cases it is practical for the farmers to harness these streams and generate power almost indefinitely at a negligible expense to the owner. This power will be of inestimable value

Tractors and implements section of laboratory



Farm electric plant section of agricultural engineering laboratory

when considered in terms of the comforts and joys it will bring to the farm home, as well as saving in time and man labor.

During the past year sixty-one surveys were made for hydroelectric installations; of these five were discarded as impractical because of local conditions, such as scattered community or too great distance from the point of consumption. Of the others, some have been installed, some are now in the process of installation, and a large percentage of the rest will be installed in the near future. The average stream surveyed will develop from one to three horsepower at an average cost of $500.

A typical farm hydroelectric installation was made on a farm about twelve miles from the college. This project was of particular interest for several reasons. First, it was successfully installed in a community where a similar plant, owned and installed by a master electrician, had failed because of the lack of advice on hydraulic problems. Second, it represents the smallest practical development of power on small streams; and third, it was a successful plant even though installed in opposition to the recommendations of water wheel manufacturers which means that originality has to be used in every phase of the work. The source of power was obtained from an insignificant spring, flowing hardly fifteen gallons per minute, which was one hundred and twenty-five feet above and 1500 feet from the residence. There was not enough available power to run even the smallest generator, so an earth dam was built below the spring to pond the water for several hours. Next a two-inch pipe line was run from the dam to a six-inch impulse water motor located in the cellar of the residence. The motor was then belted to a 36-volt ¼ kilowatt generator which charged a 90-ampere-hour storage battery for a few hours each day. This plant cost less than $450 including all labor and material, and it furnishes all necessary power for lighting, ironing, washing, churning, and other home conveniences.

The extension project in water supply and sanitation is carried on in cooperation with the home economics department. One of the engineers is devoting from one-third to one-half of his time to this important work. Last year water supply campaigns were put in two counties of the state with great success. In addition to these campaigns eighty-six water supply surveys were made and advice given on the installation. In each case an estimate of cost and list of materials was furnished. The plants ranged from the complete systems, including pumping outfit, pipe and bathroom fixtures, costing from one hundred to a thousand dollars, to the simpler system of providing water in the kitchen, costing only a few dollars. It is with the latter type of system that the most effective work has been done. In many instances it was found that an expenditure of from ten to twenty-five dollars would furnish running water in the kitchen for the housewife, who had no idea that she could enjoy this convenience without expending a large sum of money.

Many very interesting problems on water supply were handled, but perhaps the most interesting was the following project: This was interesting not because of the mechanical difficulties involved but because of the owner's hostility towards any improvements in the home. After a survey of the premises, it was found that the housewife in carrying water was walking 140 miles per year, and expending enough energy in lifting water to do the work of two horses plowing eleven acres of land. When the home demonstration agent asked the farmer if we could assist him with his water supply problem, he answered that he expected to die soon anyway and he did not want to spend any money on such things. The son, however, agreed to spend $50 toward putting water in the kitchen if we would help install the water system and "make it work." A small hydraulic ram with overhead storage, kitchen sink, and waste pipe were purchased for $49. When the equipment arrived the agricultural engineer gave a demonstration on the installation and care of the system. This demonstration was attended by a large number of farmers and a number of the members of the home economics club. The owner was confident that the system would not "work," even up to the time that the ram pumped the water into the tank. However, since enjoying the comforts of water in the kitchen, he has taken a hand himself and is planning for bathroom fixtures and all modern conveniences. Recently the department received a request from him for assistance in harnessing a small stream for the generation of electricity for home use. Since he has learned how to live, he has taken an increased interest in life and has decided to live a little longer.

With practically every water supply installation, instruction and advice is given on the sanitary disposal of sewage. Plans for septic tanks are furnished by the department. The state health department has a number of field agents working in rural communities of the state giving demonstrations in sewage disposal, which relieves this department of a great deal of work along this line. During the past year 244 bulletins and seventy plans for septic tanks were furnished farmers by this department.

The extension project in farm buildings, handled by this department, is divided into two main divisions: assistance through the regular plan service, and field assistance and personal service which includes farmstead planning. Prior to 1922, building assistance was given to the farmers only through the regular plan service. During the past year, however, considerable field assistance was given and some excellent results were obtained.

Plan booklets have been prepared for the county agents, showing the floor plan and elevation view of each standard

plan. Farmers in each county can now refer to the county agents plan booklet and select the particular plan, desired. This makes it possible to supply the farmers with the plans desired without a great exchange of correspondence. During the past year nineteen new standard and thirty-one special building plans were drawn, and complete working plans were furnished to 904 farmers.

Probably the most interesting of the farm building projects conducted last year was the designing and superintendence of construction of a large community apple packing house for the Rockingham County Fruit Growers' Association. This is the first large apple packing house constructed in the state and has created a great deal of interest among the fruit growers. In addition to the farm building demonstrations, twenty-one farmstead planning demonstrations were conducted. The most important of these projects was the rearrangement and planning of the college farmstead. All of the fields were rearranged, new fences built, several new barns designed and constructed, and old barns remodelled and painted. The change in appearance of the farm plant is hardly believable and the plant is now a credit to any institution.

Numerous requests for assistance and advice on miscellaneous engineering problems which do not come under the regular projects, are received each year from farmers, county agents, farm organizations, various departments of the college and extension division, and other state agencies. A special endeavor is made to comply with all these requests in so far as they do not interfere with the main projects of the department. During the past year 364 letters were received and answered relating to miscellaneous subjects.

The department is cooperating very closely with all the departments of the college, experiment station, and extension division, and with all other state agencies in the furtherance of the gospel of better farming. Through these cooperative relations and the extensive publicity carried on, agricultural engineering has been placed on a solid foundation in Virginia. The future looks bright for the further growth and development of all branches of agricultural engineering in the state.

Research in Agricultural Engineering

(Continued from March Issue)

By **R. W. Trullinger**
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LAND CLEARING

The subject of land clearing, while not new, has undergone a process of very gradual but steady development. The Wisconsin, Minnesota, and Oregon stations apparently have continued their comprehensive studies of land clearing methods, and the Idaho station has been also engaged in such a study, although on not so extensive a scale perhaps.

The Alabama station studied ways and means of clearing stump land in Alabama, and developed some very effective methods, all of which cost considerable money, however. A study was then entered into on a relatively small scale to find out if the expense of clearing could be met by the sale of oils, tar, etc., obtained from the stumps by destructive distillation. The preliminary results indicated that this is quite a profitable procedure, at least on the small scale followed, and it is understood that a study is now being planned in cooperation with the chemical division to develop this process on a larger and more practical scale which will include if necessary the refining of the pine stump products as a further source of profit. A highly commendable feature of this work is that it is hoped to develop a process which will pay for itself and in many cases yield a profit. It should prove especially attractive for groups of the poorer class of farmer. It is thought that all institutions dealing with land clearing could well consider these features in view of the expense of clearing.

MATERIALS OF CONSTRUCTION

Materials of construction as a subject in agricultural engineering has grown steadily in importance. While a great deal of the work done during the year has been of a comparative nature, yet most of it has served to give permanent results. A great deal of the work with lumber and with wood preservatives has been done by forestry or chemical departments. This has been true at the Ohio, Minnesota, New York Cornell, and Iowa stations on studies of the preservative treatment of fence posts. The Minnesota station has a project under the divisions of agronomy and farm management on the comparative value of fence posts of local origin when treated and used for long periods.

The Iowa station has a project on roofing materials, one on fence posts and concrete panel fences and one on cellular concrete construction for farm structures, all operating under the agricultural engineering section. The roofing studies have so far indicated that a protective layer of mica, sand, or crushed stone has a beneficial influence upon durability.

The Alabama station has a project on the preservation of wood and roofing, and the Pennslyvania station has been studying the preservation of shingles. These have shown that creosoted pitch and loblolly pine shingles have given as good results as red wood or red cedar shingles in a 13-year test. The Montana and Missouri stations and the American Wood Preservers' Association have been studying the preservative treatment of fence posts and structural timber with various chemicals. It has been found that zinc chlorid when used as a preservative decreases the strength of timbers subjected to relatively high temperatures. The University of Missouri is interested in a project on concrete fence posts.

The Montana and Wyoming stations have continued their studies on the effect of alkali upon Portland cement and the U. S. Department of Agriculture also has conducted some studies of this subject. These last have shown that the concrete highest in quality as indicated by strength and absorption best withstood the deleterious action of magnesium sulphate.

Both the Wisconsin and Minnesota stations are investigating the durability of concrete drain tile, especially in peat soils. The Minnesota studies have shown that cement tile may be used without risk in high-lime peat soils that are free from iron sulphid, but are subject to attack and possibly to disintegration in low-lime peats. The cooperative study of concrete drain tile in alkali soils being conducted by the U. S. Department of Agriculture, the U. S. Bureau of Standards, and the U. S. Reclamation Service is still in progress and has recently yielded some interesting results. The U. S. Department of Agriculture has recently studied the stresses in concrete drain tile under load in a trench. The analytical results indicate that the safe load per linear foot on such tile is greater than that allowed by the

specifications of the American Society of Testing Materials. The Department has also studied the coefficient of roughness in corrugated iron pipes on different grades.

The North Dakota agricultural college has recently reported the results of its latest paint test made in connection with the state paint regulatory work. The American Society for Testing Materials has also reported studies on stress-strain measurements of paint and oil films to determine changes and distortions therein and their causes. Studies by private parties on the relative values of paints and primers for the protection of wood against moisture have shown that paints and primers of the ordinary commercial brands are not effective as moisture proofing agents even when three coats are applied. The need for research on this subject is indicated. It is understood that the studies on the fungi injurious to paint have been continued at the New Jersey station.

The Colorado station has been studying the coefficient of heat transmission in commercial wall boards. In this connection it is well to note that the Department of Science and Industrial Research of Great Britain has been studying the thermal conductivity of insulating materials commonly used in cold storage work. So-called cellular expanded rubber consisting of rubber expanded by gas into a highly cellular form and having a high insulating value has been developed in this work.

Studies have also been in progress at Columbia University on concrete brick masonry which should be of interest to agricultural engineers. These have so far indicated that to produce masonry of the same strength, the strength requirements of individual brick would be considerably lower in the case of wet mixed-concrete brick than for clay brick.

MISCELLANEOUS

As usual, there are a few miscellaneous features of agricultural engineering being studied which are worthy of mention. The Alabama, Illinois, and Missouri stations and the Georgia agricultural college have projects on soil erosion. It is understood that all these projects include studies on water penetration, run-off, and so-called washability of soils in relation to erosion and promise to yield some interesting results. The Iowa station has a project on the harvesting and storage of ice and the Minnesota and Virginia stations on hydroelectric farm plants. The Virginia project is now in process of preliminary study and is considered to be a very important matter in that state. Considerable data have already been obtained. The University of Missouri is interested in farm lighting plants.

The University of Illinois is continuing its warm air furnace research, and has reported tests of humidity conditions in a residence heated by a warm-air furnace using recirculated air.

The Canadian Council of Science and Industrial Research has been studying fuel-saving possibilities in house-heating and a well-known federal war bureau has made available the results of study on the burning of kerosene in house-heating boilers.

It may also be well to mention the studies at the University of Nebraska on the heat value of corn. These showed the relative heat value of corn and coal, indicating that with coal at $10 per ton the price of corn on the cob must be less than twenty cents per bushel of 70 pounds and of shelled corn less than 16 cents per bushel of 56 pounds to make it more economical to burn corn than to purchase coal. This comparison does not include any allowance for the cost of handling either fuel.

While tillage and tillage methods are subjects normally related to the work of agronomists, yet their intimate relation to the development of tillage machinery justifies the inclusion of some such works as miscellaneous matters of interest to agricultural engineers. The Oregon, South Dakota, North Dakota, Illinois, Texas, Minnesota, Utah, Arkansas, South Carolina, Wisconsin, Ohio, and North Carolina stations have projects on some phase of tillage or tillage methods. In nearly every case these projects are conducted by the soils or agronomy department and in no case by the agricultural engineering department. These projects cover such important factors as depth of plowing, differential tillage, weed eradication with different machines, subsoiling, packing, disking versus plowing, time of tillage, relation of tillage to moisture and plant nutrients, seedbed preparation, etc. It would seem that cooperation with the agricultural engineers on questions of tillage might frequently be a profitable procedure.

A. S. A. E. and Related Activities

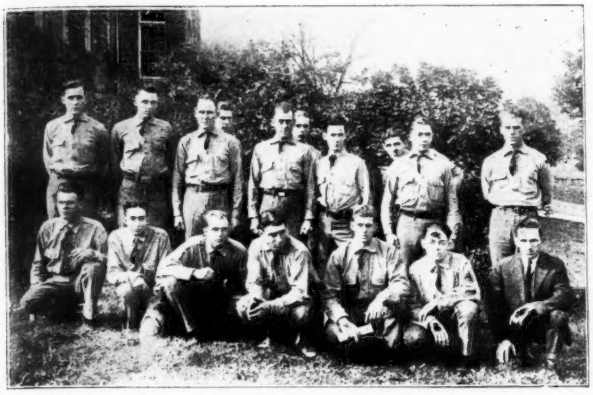
Conference on the Relation of Electricity to Agriculture

AT A MEETING held in Chicago, March 8, 1923, by representatives of the U. S. Department of Agriculture, American Farm Bureau Federation, American Society of Agricultural Engineers and the National Electric Light Association, the problem of the use of electricity in agriculture was discussed.

As a result of this conference a comprehensive study of the farm power problem was outlined. Involved in this proposed investigation will be a farm power survey covering all types of farm power generators such as horses and mules, steam engines, gas engines, windmills, electric motors, and man himself. This survey will include the collecting of data on the amount of power required for various farm operations, power requirements of various machines, and working it into such a form as to make it readily adaptable to the special problem under consideration. It was emphasized that the arriving at an economic solution of this problem required, as a first step, the fundamental analysis of all existing data.

It was further unanimously agreed that a complete survey of the present state of the use of electricity on the farm is desirable, and to this end plans were laid for an investigation which will reveal the number of farms being served by isolated plants and central station service. The National Electric Light Association will be requested to find the number of farm customers being served today, miles of rural electric lines, current used, farm operations for which electricity is used, and cost of this service to the farmer. An attempt will be made to secure similar data for the isolated plant.

It was recognized that the farmers rightfully look to the U. S. Department of Agriculture and various agricultural experiment stations for research information on fundamental agricultural problems. In view of the importance of the farm power problem it was urged that these institutions institute investigations on the application of electricity to agriculture which will ultimately place information in the farmer's hands enabling him to make intelligent decisions regarding the application of electricity to his own problems. A complete investigation of the problems in this field will be urged. As the first step in this direction the Farm Power Committee of the U. S. Department of Agriculture will be requested to undertake the farm power survey and complete it as rapidly as possible. The various interests represented perfected the organization of the Committee on the



Student branch at Virginia Polytechnic Institute

Relation of Electricity to Agriculture with J. W. Coverdale, of the American Farm Bureau Federation, as chairman, and and G. C. Neff, chairman of the Rural Lines Committee of the National Electric Light Association, as secretary.

The outline of investigations to be carried on under the general supervision of this Committee is as follows:

I—Farm power survey.

II—Survey of central station and isolated plant service to farmers.

III—Survey of agricultural uses of electricity in foreign countries.

IV—Experimental and research work on the uses of electricity in agriculture.

Professional Course in Agricultural Engineering at Virginia

AN ANNOUNCEMENT just received from Charles E. Seitz, head of the department of agricultural engineering at the Virginia Polytechnic Institute, Blacksburg, states that their course in agricultural engineering has been changed from the major course in agriculture to professional course leading to the degree of Bachelor of Science in Agricultural Engineering. This course has been adopted and is being incorporated in the new catalog of that institution which is now being published.

Conference for Standardization of Abbreviations and Symbols

A CONFERENCE to determine whether unification of abbreviations in engineering work and of symbols used in engineering equations and formulas should be undertaken was held under the auspices of the American Engineering Standards Committee on February 13. Stanley F. Morse, who represented the A. S. A. E. at the conference, reports that progress was made and he believes that its object eventually will be achieved, although several years time will probably be required to secure the desired results.

The conference voted to undertake a broad program of unification of abbreviations used in engineering and scientific reports, tables, publications, etc.; this also includes symbols for quantities in engineering equations and formulas. It was decided that a central committee should be constituted with the power of arranging subcommittees as may be found desirable for abbreviations, mathematical symbols, and graphical symbols. The conference went on record as not favoring that the proposed general committee take up work on definitions of terms used in engineering and scientific practice. Provision is also made for cooperation with similar activities in foreign countries.

The sponsor or sponsors for the development of the work initiated by the conference will be made by the American Engineering Standards Committee under its usual procedure. In this connection the conference recommended for consideration as possible sponsors the American Association for the Advancement of Science, Engineering Foundation, National Research Council, Society for the Promotion of Engineering Education, and the U. S. Bureau of Standards.

Student Branch Activities

VIRGINIA POLYTECHNIC INSTITUTE

THE first meeting of the A. S. A. E. Student Branch at the Virginia Polytechnic Institute was held on October 5, 1922, and was given over to the election of officers, reading and adoption of the constitution and by-laws, and the appointment of a program committee, membership committee, and publicity committee. Since that time regular meetings have been held on every second and fourth Thursday evening of each month. Exceptionally good programs have been given at these meetings, and the following papers have been presented: "Elements of Carburetion," by W. F. Simpson; "The Edison Cell," by F. M. Somerville; "Value of Accessibility to all Working Parts of the Tractor Motor," by J. B. Cole; "Farm Water Supply Systems and Their Adaptability," by H. L. Cooke; "Lead Storage Batteries," by M. C. Pittenger; "Cooling Systems," by J. N. Harper; "Valve Timing," by C. H. Robson; "Influence of Livestock on Design of Buildings," by H. M. Wallace; "Principles of Ignition," by A. B. Mackey; and "Tile Trenching Machinery," by H. R. Parks.

The papers presented were not only instructive to the student members, but their preparation proved of no small value to the authors.

The branch held a smoker on November 9 at the Y. M. C. A. reception hall, at which time several interesting talks were made on the future work of the branch and the benefits that could be derived from it. Music was furnished for the event by "Phillips Big Five." Many of the members exhibited their skill in stunts and tricks of all kinds. The affair was such a success that the branch is now planning for a big social which is to be original in every respect and different from the usual socials at that institution.

Aims of Pacific Coast A.S.A.E. Members Formulated

THE field of agricultural engineering was made greater when about seventy-five men interested in its extension to include the western part of the United States met in San Francisco on December 15, 1922, to discuss plans for the further development of the activities of the American Society of Agricultural Engineers. After a very instructive program followed by a banquet a committee of six were elected from those present to make definite plans to place the agricultural engineering interests of the West in closer touch with the parent Society which for years had been holding its annual meeting in Chicago. At a meeting of this committee held Thursday, March 22, at the College of Agriculture at Berkeley, the aims of the Western members of the Society were formulated.

Dr. Elwood Mead was made chairman of the committee, and the aims of the Western members were outlined as follows:

1. To place before all members through the various publications of the Society the agricultural-engineering problems of the West.

2. To give proper and due publicity to the activities of the Society to the general public in order that the construc-

tive benefits of the Society be not confined merely to those who are now members.

3. To establish a program of fundamental research into the different phases of agricultural engineering especially drainage, farm buildings, materials, farmstead planning, farm motors, electric power used for agricultural purposes, farm machinery, irrigation, pumping machinery, concrete, costs of changing raw land into improved farms, and methods of financing the above operations.

4. To investigate the rural community as a means through which all phases of agricultural engineering may most economically be utilized and to develop plans for the organization of communities on a sound business basis for cooperation in farm business.

5. To plan a professional meeting of the Society in Berkeley in 1923 and a national meeting of the Society in San Francisco in 1924 where the results of these studies can be discussed, disseminated and made of general utility.

Civil Service Examination for Dust Explosion Prevention Engineers

THE U. S. Civil Service Commission announces an open competitive examination for "dust explosion prevention engineers" to be held on April 25 for positions of junior dust explosion prevention engineer to fill vacancies in the Bureau of Chemistry, Department of Agriculture. An examination will also be held on April 24 for positions of assistant dust explosion prevention engineer and associate dust explosion prevention engineer. The duties of these positions are in connection with investigations relative to the cause and prevention of dust explosions and resulting fires. Applicants must qualify in at least one of the following engineering branches: Chemical, milling, mechanical, electrical, electro-chemical, mining, industrial, civil, agricultural, or ventilation engineering. Full information and application blanks may be obtained from the U. S. Civil Service Commission, Washington, or the secretary of the board of U. S. civil service examiners at the post office or customhouse in any city.

Wood Testing Methods to be Standardized

INNUMERABLE misunderstandings and disagreements concerning strength of lumber and timbers, and such accidents as grow out of miscalculation of the strength of various kinds of lumber should be greatly reduced as a result of the standardization of methods of testing wood, recently undertaken by the many interests involved, under the auspices of the American Engineering Standards Committee.

The U. S. Forest Service and the American Society for Testing Materials have been appointed joint sponsors for this undertaking, and sixteen additional organizations are represented on the sectional committee which is to make an intensive study of the subject.

The scope of the committee's activities embraces the standardization of physical (including mechanical) tests of wood specimens. Of immediate importance is the application of these tests to (a) small clear specimens and (b) structural timbers. The most important desideratum involved is the establishment of standard practice in testing wood which will make data obtained at different sources of the broadest possible value and insure the attainment of comparable results.

L. J. Markwardt, of the U. S. Forest Products Laboratories at Madison, Wisconsin, is chairman, and Prof. M. O. Withey, professor of mechanics, University of Wisconsin is secretary of the sectional committee.

New Members of the Society

FRANK J. HUSE, Hollow Building Tile Association, Conway Building, Chicago, Illinois. (Member).

L. P. KEITH, structural department of West Coast Forest Products Bureau, 3851 Grand Central Terminal, New York City. (Member).

G. C. NEFF, Wisconsin River Power Company, 14 Carroll Street, Madison, Wisconsin. (Member).

WALTER E. PACKARD, State Department of Public Works, Delhi, California. (Member).

APPLICATION FOR TRANSFER OF GRADE

GEORGE E. TOMM, Delavan, Illinois.
(From Student Branch to Associate Member).

Applicants for Membership

The following is a list of applicants for membership received since the publication of the March issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to the applicants for the consideration of the Council prior to election.

Jesse Bernard Bookhardt, State College Station, Raleigh, North Carolina.

J. G. Fisher, Box 27, Goodyear, Arizona.

H. B. Josephson, department of agricultural engineering, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

EMPLOYMENT SERVICE

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members, as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

MECHANICAL AND ELECTRICAL ENGINEER, graduate of Cornell University and Armour Institute, with nineteen years of practical experience in designing, manufacturing, and marketing gasoline engines, automobiles, motor trucks and tractors, having specialized particularly on internal-combustion motors and their application, prefers mechanical work cooperating with the different manufacturing and sales departments along the lines of sales engineering, or other work into which his qualifications would fit. MA-104

AGRICULTURAL ENGINEER wants position in southwest. Graduate of University of Illinois 1915, five years practical experience on Illinois farm with power equipment, two years in charge of the agricultural engineering department New Mexico College of Agriculture; considerable garage experience and service experience on unit power and light plants. Also one summer in Philadelphia battery service station. MA-106

AGRICULTURAL ENGINEER, graduate in mechanical engineering at Michigan Agricultural College, desires position teaching all kinds of farm machinery or automotive work, or with some farm-equipment manufacturer. Will be available April 1, 1922. Has served one year as instructor in tractors and trucks, and one year conducting service schools for a leading tractor manufacturer. Can furnish best of references. MA-110

GRADUATE AGRICULTURAL ENGINEER, now employed by tractor company, wishes position teaching agricultural engineering work. Will be available in summer or to start next fall. MA-115.

AGRICULTURAL ENGINEER, graduating from University of Illinois at end of present semester (available March 1, 1923) would like position in service department or experimental department of company manufacturing tractors or farm machinery. Three years' practical farm experience in West and one year in Illinois. Age 27. Unmarried. MA-116.

DEVELOPMENT AND RESEARCH ENGINEER, technical graduate, inventive ability, practical, experienced in the development, design, manufacture, and distribution of farm machinery. Can carry through from the embryo idea, through development stages, production in manufacturing, and marketing. Age 29. Married. Excellent character. Available immediately. MA-117.

Positions Open

DRAFTSMAN who has had experience in designing and manufacturing threshing machinery with reliable, well-established farm-machinery manufacturer in central Pennsylvania. PO-1.

DRAFTSMAN to assist in designing threshing machinery and gas tractors with well-established manufacturer of farm machinery in the East. PO-2.

STUDENT FELLOWS OR INSTRUCTOR IN DRAINAGE. The department of soils of the Oregon State Agricultural College will be able to use two student fellows, one in pure soils and one in soil irrigation and drainage work, if they can be promptly located, or an instructor in drainage if fellows are now secured. Write W. L. Powers, chief in soils, Corvallis, Oregon. PO-3.

STUDENT FELLOW IN AGRICULTURAL ENGINEERING. There will be an opening beginning September, 1923, for a student fellow in agricultural engineering at the Virginia Polytechnic Institute. Write Charles E. Seitz, department of agricultural engineering, Virginia Polytechnic Institute, Blacksburg, Virginia. PO-4.